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Summary of the Presentation Notes from the Symposium on Urban Soil Lead Abatement

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DISCLAIMER

This is a transcription of handwritten notes taken from the presentations given at the USLADP Symposium and reviewed by the presenters. The summaries are interpretations and were not taken verbatim. The content of the Symposium presentations is based on preliminary data from city specific project reports which are currently under final review by the EPA. Data are being reanalyzed by the EPA and are subject to change. The information presented here should not be construed to represent agency policy.

SUMMARY OF THE PRESENTATION NOTES FROM THE SYMPOSIUM ON URBAN SOIL LEAD ABATEMENT
Research Triangle Park, NC August 5-6, 1992

SESSION I: Overview of the Urban Soil Lead Abatement Demonstration Project (Chair: Lisa Matthews)

SUMMARY OF STUDY DESIGNS: Differences and Similarities (R. Elias)

Evolution of Study Objectives:

- The first study objective was to prove that soil abatement effectively lowers the blood lead levels in children.
- The original study design was modified and adjusted to include the hypothesis that soil abatement reduces lead exposure.
- Abatement was performed on both single properties and entire neighborhoods.
- In addition, sources of lead exposure other than soil were studied.
- The study was not designed to evaluate various methods of abatement.
- Common protocols were devised for:
  - soil analysis
  - handwipe analysis
  - blood sampling analysis
  - dust sampling

BOSTON - General Approach and Summary of Conclusions (M. Weitzman)

Limitations and Concerns:

- Study does not tell us about children with blood lead levels of $\geq$25µg/dL (Boston study had truncated blood lead levels of 7-24 µg/dL).
- Abated single houses (per property basis), not entire neighborhoods.
- Study only tests soil abatement as a secondary prevention strategy, not a primary prevention strategy.
- Follow-up was limited to one year.

Implications:

- Lead in soil does impact blood lead levels to a modest degree
- Public Health Implications:
  -Soil lead concentration is at the surface
  -Substantial societal impact - Positive effects of soil removal may be seen in multiple generations.

BALTIMORE - General Approach and Summary of Conclusions (K. Farrell)

Conclusions:

- Found evidence that soil abatement alone as a preventative strategy had no effect on reducing blood lead levels levels in urban children.
- Soil abatement is not an effective strategy for Baltimore as a single source of reducing blood lead levels levels; however, it is not ruled out as an intervention for individual lead poisoned children as long as other sources are also abated.
- Principal source of Pb exposure is Pb based paint and dust.
- Levels of lead in soil were lower than expected in Baltimore.

Explanations for Conclusion:

- Low levels of lead in soil in Baltimore did not result in significant exposure to children.

CINCINNATI - General Approach and Summary of Conclusions (S. Clark, B. Menrath)

Conclusions:

- Exterior Dust Abatement - Recontamination of paved areas occurred within weeks after abatement.
- Interior Dust Abatement - A reduction in interior dust lead loading was observed and was directly correlated to interior dust lead abatement. Recontamination of about 50% occurred after one year.
- Blood and Hand Lead - No evidence was found that soil and/or dust lead abatement reduced blood or hand lead levels.
- Soil Lead Abatement - Soil lead abatement was achieved, and there was no evidence of soil recontamination after two years.

Follow-Up Items:

Use of Geographic Information System (GIS) Capabilities

- Develop neighborhood exterior dust lead and soil exposure indices for each child. Determine the usefulness of these indices in models and correlations.
- Determine impact of location of measurement area within study boundaries on lead loading and recontamination.
- Determine if relationships exist between paved area lead concentrations and loadings and soil lead concentrations and surface condition.
- Determine impact of prevailing wind and precipitation on surface dust lead levels.

Interior Dust Lead Abatement

- Was extent of reduction of interior surface dust lead loading a function of the effectiveness of abatement as measured by: (1) number of old upholstered furniture items remaining in dwelling; (2) length of time since family lived in non-rehabilitated housing; (3) whether or not owner gave permission to abate common interior and exterior areas of apartment building; and, (4) proximity to non-rehabilitated buildings.
- Was impact of interior dust lead abatement the same for "non-rehab" housing as for "rehab" housing?
- Did re-contamination occur at a slower rate in non-rehabilitated houses (i.e., influence of exterior environment was less)?
- Determine interior recontamination rates when exterior dust lead loadings are kept "low" by repetitive exterior abatement.

SESSION II: Results of Environmental and Biological Measurements (Chair: Bev Fletcher)

Intercalibration and QA/QC (D. Boyer, H. Vincent)

Summary:

- Accurately and precisely prepared audit wipes
- Homogenized and characterized audit soils and dusts
- Created and distributed soil and dust standards
- Derived 95% confidence intervals for data acceptance
  - necessary to have data from a minimum of five laboratories to obtain good information
- Provided interpretive support

Recommendation:

- Include Certified Reference Materials (CRM) for intercalibration studies.
- Study soil lead standards are available on a limited basis.
- NIST is working on developing soil lead standards.

BOSTON - Environmental and Biological Results (A. Aschengrau)

Findings:

- Lead contamination in Boston comes from many sources and is found in different media such as soil, dust, water, and paint.
- The median floor dust lead concentrations in the groups that received interior dust abatement were substantially lower 4-5 weeks following abatement. The levels remained substantially below baseline levels for an average of 33 weeks post-abatement.
- The median window well dust concentrations were also substantially reduced an average of 4-5 weeks after interior dust abatement and remained below baseline levels for an average of 33 weeks post-abatement. During this time window well dust lead loading increased.
- Study group blood lead levels levels dropped significantly more than did the control group (statistically significant).
- Soil abatement alone resulted in a 0.8 - 1.4 μg/dL decline in blood lead levels, and soil and dust abatement together resulted in a 1.2 - 1.6 μg/dL decline in blood lead levels.
- Changes in hand lead were not significantly different between the control and the study groups.

- The median surface soil lead level in the study group had not increased nine months after soil abatement. However, eight properties showed evidence of recontamination, and all but one of the eight properties had low levels of recontamination.

Questions:

To what is recontamination attributed?

Interior dust was cleaned up only one time, so the lead was not completely removed. The paint was not abated; however, loose paint was stabilized.

Did you look to see if children with higher soil lead levels had higher blood lead reduction?

A dose-response relationship was not found.

BALTIMORE - Environmental and Biological Results (M. Brophy)

Study Complications:

- Slow recruitment.
- Weather (drought in first year).
- Long period of biological testing pre-abatement.
- Two paint stabilization contracts covered the 100 houses involved in the study.

Findings:

- Pre-abatement soil lead concentrations and dust lead levels were similar between the Control and the Study Groups.
- There was a significant reduction of soil lead in the Study Group; however only a moderate reduction in dust lead.
- The lack of reduction in dust lead levels may be attributed to no interior dust clean-up.
- There was a reduction in dust lead in Control Group - no soil was removed.
- Pre-abatement hand lead levels were similar between Study and Control Groups.
- Soil abatement did not have an effect on lowering blood lead levels.
- Soil abatement did not have an effect on hand lead levels.

CINCINNATI - Environmental and Biological Results (S. Clark)

Exterior Dust Abatement Conclusions:

- Recontamination of paved areas often occurred immediately after abatement.
- Where evidence for an abatement was found, its impact was not evident at the next sampling phase.
- There were wide fluctuations in exterior dust lead that were not associated with times of abatement.

Interior Dust Abatement Conclusions:

- There was evidence for a reduction in interior dust lead loading that was associated with interior dust lead abatement.
- Recontamination of about 50% was evident after one year.
- Wide fluctuations in interior dust lead occurred over time. The fluctuations were not associated with the timing of the abatement activities. These wide fluctuations overwhelmed the impact of abatement.

Blood and Hand Lead Conclusions:

- There was no evidence that soil and/or dust lead abatement reduced blood or hand lead levels.
- The pre-abatement relationships between blood and hand lead and environmental lead were similar to those previously found for children in the same areas.

Soil Lead Abatement Conclusions:

- Soil lead abatement was achieved.
- There was no evidence for soil recontamination over the period of measurement (up to about two years).

Exterior Dust Abatement Concerns:

- Was the smaller than expected reduction in exterior dust lead loading a result of: too much time elapsing pre-abatement, or post-abatement monitoring occurring too far after abatement?
- What is the role of local precipitation in determining exterior dust lead loadings?

Possible Follow-up Activities:

- Perform extensive monitoring of sub-study areas immediately before and after dust abatement of paved areas that surround "local sources".
- What are factors influencing faster than anticipated recontamination?
- Do "reservoirs" of exterior dust lead have a decreasing impact on recontamination rates with repeat vacuum cleaning?
  Perform pre/post monitoring in vicinity of building demolition projects.
  Use GIS to identify patterns of recontamination and to help identify local sources.

Panel Discussion (M. Weitzman, Boston; M. Brophy, Baltimore; S. Clark, Cincinnati)

Comment on the feasibility of the Soil Abatement procedure to reduce blood lead levels.

Boston: Dr. Weitzman believes that lead is a multi-media exposure problem, and soil abatement alone won't work. Economically speaking, soil abatement is feasible; however, there are other issues to consider; such as, its effectiveness, what contributes to the lead in soil, dust, etc.

Baltimore: Our multi-media exposures are similar to Boston's. However, we feel that soil abatement by itself is not effective in reducing blood lead levels; there are other effective means to monitor and abate lead.

Cincinnati: We have shown that soil lead abatement is both technically and economically feasible. The impact of soil lead abatement on blood lead, both in extent and timing, would depend on the situation involved since lead exposure is, in general, multi-media in nature. Soil lead abatement should be considered in any comprehensive lead exposure reduction project. In conducting soil lead abatement it is not adequate to merely cover the contaminated soil with sod or grass seed. Vegetation usually does not stand up well to extensive activity such as in play areas. In addition, even if an area is currently a "low-use" area with fairly extensive grass cover, the situation can be rapidly altered with new residents and/or changes in activity patterns.

With regard to dust abatement, what is the minimally effective abatable unit for abating dust?

Cincinnati: For interior dust abatement, the minimally effective unit would depend on the homogeneity of the neighborhood. If the unit being abated contained more available lead than did surrounding neighborhoods, its

abatement alone would be relatively long-lasting. In a situation, such as ours, where the housing units within the building were homogenous, but the buildings in the neighborhood frequently were not, a single unit dust abatement may not be effective for more than several months. Exterior dust abatement can not effectively be carried out if the sources of lead are not addressed. The size of the area depends on the zone of influence of these sources and their rates of dispersion. A system of repeat cleanings would probably be necessary in all situations with the frequency decreasing as the sources become more effectively contained or removed.

Were the low soil and dust lead levels a surprise to the cities?

Baltimore: Yes, they were somewhat surprised. They expected to see higher soil lead levels.

Cincinnati: No, they were not surprised since they analyzed entire neighborhoods and expected many of the newer playground areas to be fairly low in lead concentration.

An response was requested to the following statement: Boston: High estimated soil levels with a modest decline in blood lead levels; Baltimore: Low soil lead levels, with little decline in blood lead levels; and, Cincinnati: Low soil levels with no evidence of a decline in blood lead levels.

Boston: They found that soil lead modestly impacts blood lead levels. Limitations arose by abating single properties, by limiting follow-up to one year, and by testing soil abatement as a secondary rather than a primary prevention strategy.

Baltimore: Baltimore also discovered that soil lead has no impact on blood lead levels. Baltimore did not do any interior dust abatement, which they believe could be a major contributor to childhood lead poisoning.

Cincinnati: Cincinnati did not see any decline in blood lead with respect to soil lead abatement. Cincinnati believes that they should focus on the sources of lead in the exterior dust. Recontamination will occur unless sources are remediated, either by removal or containment.

SESSION III: Interpretation of Hand and Blood Lead Data (Chair: P. Van Leeuwen)

Statistical Methodology (A. Marcus)

There are enough similarities between the three studies that comparisons can be made.

The preliminary findings in Boston showed a significant reduction in blood lead related to a reduction in direct soil exposure as well as a direct and an indirect reduction of dust lead and recontamination exposure. HOWEVER, many numerical pathways became non-significant when combining factors.

Uncertainty exists in quantifying reduced blood lead and environmental lead levels due to measurement and repeat sampling variability.

The relationship between soil lead and hand lead appears to be statistically significant.

BOSTON: Statistical Models and Conclusions of the Boston Study (A. Beiser)

The following potentially confounding variables were considered in the Boston study: age, gender, socioeconomic status, race, ferretin level, mouthing behaviors, handwashing before meals, handwashing after outside, outdoor eating, play/sit on floor inside, yard play, smoking in house, outdoor pets, time away from home, time away from study area, owner occupied premises, canned food eaten, imported canned food eaten, paint lead, chipping paint, water lead, household members with lead related jobs, household members with lead related hobbies.

Findings:

- Controlling for the above variables did not greatly change the difference between the Control and the Study groups.
- There does not appear to be a dose-response relationship according to starting soil lead level or size of abated yard.
- Race was an important confounder, but there was not a statistically significant difference in the effectiveness of the intervention between people of different races.

Questions:

Race was the biggest confounder in the study. (1) Are there any pre-abatement soil lead differences among racial groups? (2) Could any pre-treatment have caused the initial blood lead differences? (3) How can you account for the soil lead changes in non-soil lead treatment groups.

(1) No, there were no pre-abatement soil lead differences among racial groups. (2) No, pre-treatment did not occur. (3) Recontamination sampling took place nine months later, and perhaps not in the same exact spot. Yard measurements could be variable.

BALTIMORE: Statistical Models and Conclusions of the Boston Study (W. Strauss)

Project Design:

- Abate soil
- Exterior paint stabilization

As well as the original members, the Control Group consisted of people originally in the Study Group, but who were found to have soil lead levels of <500ppm.

Conclusions:

- Age has a non-linear relationship with blood lead (older children have lower blood leads).
- Lower socioeconomic status is associated with a higher blood lead level.
- Blood lead levels were higher in the summer.
- None of the analyses showed a significant drop in blood lead due to soil removal.
- There is a positive association between blood lead and hand lead.
- Hand lead and blood lead is slightly higher for children who exhibit strong mouthing behaviors.
- None of the analyses showed a significant drop in hand lead levels due to soil removal.
- Hand lead levels are higher in the summer.
- Dust lead relationship with hand lead is statistically significant.
- The soil lead association with hand lead is positive but not statistically significant

CINCINNATI: Statistical Models and Conclusions of the Cincinnati Study (B. Bornschein)

Independent Variables in the Cincinnati Study:

- Age and age^2
- Occupation/hobbies
- Socioeconomic status
- Age of the house
- Leaded exterior paint
- Leaded interior paint
- Mouthing behavior
- Gender
- Study area (3 study areas)
- Neighborhood (6 neighborhoods)
- Housing type (2 types of housing)
- Building (variability smaller among children living in same building)
- Family (lead cluster among families)

Dependent Variables used in the Cincinnati Study:

- Lead
- Lead (log transformed)
- Lead ratio (pre abatement vs. post abatement)
- Differential lead (pre abatement vs. post abatement)
- Hand lead (same categories as above)

Interior dust recontamination occurs after about 6 months.

Area wide dust is very important - dust from soil is not the issue.

Dust comes from abandoned buildings, demolitions, etc. within the neighborhood.

Cincinnati expressed a concern about combining data from the three cities because the environmental measurement and abatement strategies were similar but not identical across cities. More importantly, the physical relationship between soil and the child's residence was quite different across cities.

Questions:

Comment on the nutritional status of the children in the study.

Some indicators, such as iron status, were measured. We have previously conducted dietary studies on the children in these neighborhoods. Their diet is adequate, but their meal pattern is irregular.

Are paved surfaces cleanable? Or are they like carpets?

There is not enough quantifiable information to answer the question. In cases of crumbling sidewalks, the pavement was replaced.

Structure and Availability of Project Databases (R. Elias)

Dataset:

- Remove identification markers of individuals and residences to protect participants.
- Dataset will be arranged so that each city's data is separate but can be compared.
- ASCII format
- January, 1993 scheduled release

How to get datasets and other information (requests limited to Symposium attendees):

FAX: (919) 541-0245

Item:	Availability
• Soil and dust protocols	Now
• Interim Report	Now
• Symposium Attendee List	Sept, 1992
• Individual Presentations	As they are given to Rob
• Project Reports: Exec Summary	Expected Sept 30, 1992
• Complete Project Reports	Expected Sept 30, 1992
• Integrated Report	Expected Jan, 1993
• Project Databases	Expected Jan, 1993

SESSION IV: Implication of USLADP Study for Lead Abatement and Exposure Reduction (Chair: R. Elias)

Panel Discussion: Summary of Study Findings (D. McIntyre, Boston; K. Farrell, Baltimore; B. Bornschein, Cincinnati)

Was there a field sampling protocol?

Boston: Yes, there was a field sampling protocol. We weren't concerned about the exact reproduction of data. We gridded the yard for sampling at the surface and at 6". Samples were taken at five points from a one square foot area (four corners and the center). The soil was then dried, sieved, and analyzed using XRF.

Baltimore: The three cities used a standardized protocol for environmental samples. We expressed concern that we achieve a representative sample for the soil lead - we expected to find variations in the lead levels. We flagged the areas that were originally sampled and resampled the same areas. We believe that we had enough samples to represent each property.

Cincinnati: Meetings were held with the three cities to map out a soil sampling strategy. The strategy is described in the reports. We collected three samples - surface scraping; top 2cm; and 13-15cm deep. Ten percent of the field samples were immediately resampled. Post-abatement resampling concentrated on collecting surface samples.

Does the Boston report confound the effects of ethnic groups?

Boston: The data presented in the reports shows estimated effect among races. It is a stratified estimate and is not statistically significant among races.

How representative are the data of (1a) the cities, (1b) the typical American profile? (2) How did the studies evolve from the original study's intent?

Boston: (1a) Yes, it is representative of Boston around wooden structures older than fifty years. (1b) The data is typical of the northeast around older wooden structures that were painted with lead paint.

Baltimore: (1a) No. We were not looking for typical Baltimore conditions. There were specific criteria to follow. We could probably find other neighborhoods/cities similar to our Study and Control groups, but that was not the purpose of the study.

Cincinnati: (1a) The neighborhoods are representative of the lead belt in Cincinnati - the area generating the most cases. (1b) The study is representative of cities with inner-city neighborhoods like Cincinnati. (2) there were selection criteria which included a number of lead exposure factors as well as relevant organizational parameters.

Please comment on the equilibration of blood lead and the environment, and the resulting impact on bone lead.

Baltimore: We assume that it takes three months for the lead to equilibrate with the environment and consequently used a three month residency requirement on our subjects.

Cincinnati: The important factor is that the body stores lead. Older children have larger body stores; therefore, blood lead in older children reflects historical exposure not related to current environmental factors. The focus should be placed on younger children when evaluating the effects of abatement.

How do you compare blood leads lowered by putting children in clean houses/areas to leaving children in unabated, contaminated areas?

Cincinnati: Blood lead levels are significantly reduced if an individual moves to a "low lead" neighborhood. However, blood lead levels will not be significantly reduced if the family takes contaminated rugs and furniture to the new residence.

Is it achievable to get blood lead levels to below 10 μg/dL by relocating children?

Cincinnati: It is possible, but not practical since there is not enough housing available in Cincinnati. Children in public housing do have lower blood lead levels than children living in old housing in which lead paint has been totally abated.

Implications for the Public Health Community (J. Chisolm)

Hypothesis was not supported by three cities' studies for several reasons:

- Multiple exposures where soil lead was lower than expected.
- Studies on human design are never clean and simple
  - Baltimore did not stabilize interior paint
  - Baltimore and Boston did not treat contaminated furnishings

Blood lead levels will drop nationwide due to several circumstances:

- Reduction of leaded gasoline.
- Removal of canned foods with lead seams.
- Emissions stationary at point sources (areas evacuated in close proximity)

Study Complications:

- Primary source of lead (paint) was not addressed in the study, interior dust was not systematically addressed.
- **Need to address the primary source first and then figure out how to address secondary sources.**
- The majority of studies were done away from lead smelters.
- The study areas were small, in terms of geographic area, where wind/traffic can recontaminate very quickly.

Soil abatement is not a cost-effective strategy for removing lead. It could, however, be used in conjunction with other remedies.

EPA Urban Lead Update (M. Shapiro, D. Cantor)

Progress for developing strategy/policy:

- Treating exposures comprehensively.
  - multi-media (lead paint, household dust, soil lead)

- Finding solutions require extensive planning involving both the government and the private sector.

- EPA and other Federal Agencies are working together on an Inter-Agency Task Force on Lead.

Inter-Agency Task Force:

- Housing and Urban Development (HUD): HUD has primary jurisdiction over the use of lead paint in residences. HUD conducted a national survey on paint and soil around houses. They are involved in the Congressional mandate for the inspection of housing.

- Center for Disease Control (CDC): Testing children's blood lead levels (children under 6). Provides grants to help screening and public education.

- Environmental Protection Agency (EPA): Mission is to ensure: (1) effective abatement technologies; (2) the existence of an infrastructure; (3) heightened awareness of education of lead poisoning.

Policy Measures:

- Improve detection/measurement methods.
  - Portable detection units, analytical labs
- Improvement of abatement techniques.
  - Effectiveness increases, cost decreases
- How to dispose of debris.
  - Reassess hazards of land disposal of lead-based paint abatement debris.

Programs:

- Public education
- Train lead abaters, inspectors, supervisors
- Research program
  - Recontamination - long term reductions
  - Determination of trigger levels for abatement

Targeted public education program:

- Implementation of Federal lead poisoning hotline in Fall, 1992.
- President's Commission on Environmental Quality (PCEQ) Campaign for education/heightened awareness in Fall, 1992.
- Development of materials for high risk children.
- Identification of geographic hot spots.
- EPA supported pilot/demo programs.
- Development of health based standards for paint, soil, dust.
- Development of Regional strategies (risk assessment, etc).

Concerns:

- Prevention of elevated blood lead levels.
- Reduction of elevated blood lead levels.

Research Recommendations

- Biokinetic modeling
- Use of data for further analyses - intimate involvement by cities
- Seasonal variation, socioeconomic status
- Behavioral changes that occur with heightened knowledge/awareness
- Handling materials that have been removed
- Consider areas or single houses here and there
- Does human iron deficiency cause higher lead absorption?
  Calcium and iron in primates
  Connecting lead sources and how they relate to bioavailability
- Learning about properties of dust collected - source samples - multi element traces
- Causes of recontamination